

TOPIC: Materials Preparation, Applications in Fundamental Research

Precision Machining, Polishing and Measurement of Mechanical and Toxicological Properties of Lead Tungstate Crystals for the CMS Electromagnetic Calorimeter

Craig R. Wuest, Baruch A. Fuchs
Lawrence Livermore National Laboratory
P. O. Box 808 L-291
Livermore, CA 94551 USA

We have developed new machining and polishing techniques that have previously been applied to large scintillating crystal arrays for high energy physics such as the Barium Fluoride Electromagnetic Calorimeter for the GEM Detector at SSCL, the CMS Lead Tungstate Electromagnetic Calorimeter at LHC at CERN and the CsI Electromagnetic Calorimeter for the BaBar Detector at PEP-II B Factory at SLAC. We discuss earlier results achieved on barium fluoride, cerium fluoride and cesium iodide with diamond machining and polishing methods and present new results on diamond machining of lead tungstate crystals. Results on diamond machining of crystals show that in certain cases crystalline surfaces without sub-surface damage or deformation can be achieved as verified by Rutherford Back-scattering (RBS) analysis. Surface roughness of about 10-20 angstroms and sub-micron mechanical tolerances have been demonstrated on large samples. We present planned applications of these machining methods for the characterization of lead tungstate boules at the production factories prior to full machining. Additionally we will present new results on mechanical properties of lead tungstate including toxicological data important for the safe handling and processing of this material. This work performed under the auspices of the US Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.